

We claim:

1. A method of forming a silicon-germanium layer on an insulator, comprising:

preparing a silicon substrate;

depositing a layer of silicon-germanium on the silicon substrate to form a

silicon/silicon-germanium portion;

implanting hydrogen ions in the silicon-germanium layer;

preparing an insulator substrate;

bonding the silicon/silicon-germanium portion to the insulator substrate with the silicon-germanium layer in contact with the insulator substrate to form a bonded entity;

curing the bonded entity; and

thermally annealing the bonded entity to split the bonded entity into a silicon/silicon-germanium portion and a silicon-germanium-on-insulator portion and to relax the silicon germanium layers.

2. The method of claim 1 which further includes depositing an epitaxial silicon layer on the hydrogen-implanted silicon germanium layer before said bonding; and removing the silicon germanium layer from the silicon-germanium-on-insulator portion after said thermal annealing to form a relaxed silicon-on-insulator portion.

3. The method of claim 1 wherein said preparing an insulator substrate includes preparing a glass substrate.

4. The method of claim 1 wherein said depositing a layer of silicon-germanium on the silicon substrate includes depositing a layer of silicon-germanium to a thickness of between about 20 nm to 100 nm in biaxial compression strain form at a germanium concentration of between about 10% to 60%, and wherein the germanium concentration is distributed in the layer taken from
5 the group of distributions consisting of uniform distribution and graded distribution.

5. The method of claim 1 wherein said implanting hydrogen ions in the silicon-germanium layer includes implanting hydrogen ions taken from the group of hydrogen ions consisting of H^+ ions and H_2^+ ions, at an ion dose of between about $1 \cdot 10^{16} \text{ cm}^{-2}$ and $5 \cdot 10^{17} \text{ cm}^{-2}$ at an
10 energy of between about 1 keV to 300 keV.

6. The method of claim 5 which includes implanting ions taken from the group of ions consisting of argon, helium and boron.

15 7. The method of claim 1 wherein said bonding the silicon/silicon-germanium portion to the insulator substrate with the silicon-germanium layer in contact with the insulator substrate to form a bonded entity includes bonding by direct wafer bonding.

8. The method of claim 1 wherein said curing the bonded entity includes curing the bonded entity at a temperature of between about 150°C to 250°C for a time of between about one hour to fourteen hours.

5 9. The method of claim 1 wherein said thermally annealing the bonded entity includes annealing the bonded entity at a temperature of between about 350°C to 700°C for a time of between about 30 minutes to four hours.

10. A method of forming a silicon-germanium layer on a glass substrate, comprising:
preparing a silicon substrate;

depositing a layer of silicon-germanium on the silicon substrate to form a
silicon/silicon-germanium portion;

5 implanting hydrogen ions in the silicon-germanium layer;

preparing a glass substrate;

bonding the silicon/silicon-germanium portion to the glass substrate by direct wafer
bonding with the silicon-germanium layer in contact with the glass substrate to form a bonded
entity;

10 curing the bonded entity at a temperature of between about 150°C to 250°C for a
time of between about one hour to fourteen hours; and

thermally annealing the bonded entity at a temperature of between about 350°C to
700°C for a time of between about 30 minutes to four hours to split the bonded entity into a
silicon/silicon-germanium portion and a silicon-germanium-on-glass portion and to relax the
15 silicon germanium layers.

11. The method of claim 10 which further includes depositing an epitaxial silicon layer
on the hydrogen-implanted silicon germanium layer before said bonding; and removing the silicon
germanium layer from the silicon-germanium-on-glass portion after said thermal annealing to form
20 a relaxed silicon-on-glass portion.

12. The method of claim 10 wherein said depositing a layer of silicon-germanium on the silicon substrate includes depositing a layer of silicon-germanium to a thickness of between about 20 nm to 100 nm in biaxial compression strain form at a germanium concentration of between about 10% to 60%, and wherein the germanium concentration is distributed in the layer
5 taken from the group of distributions consisting of uniform distribution and graded distribution.

13. The method of claim 10 wherein said implanting hydrogen ions in the silicon-germanium layer includes implanting hydrogen ions taken from the group of hydrogen ions consisting of H^+ ions and H_2^+ ions, at an ion dose of between about $1 \cdot 10^{16} \text{ cm}^{-2}$ and $5 \cdot 10^{17} \text{ cm}^{-2}$ at an
10 energy of between about 1 keV to 300 keV.

14. The method of claim 13 which includes implanting ions taken from the group of ions consisting of argon, helium and boron.